SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 20.—Some further Remarks on Red-water or Texas Fever. By Alexander Edington, M.B., F.R.S.E., Director of the Bacteriological Institute, Cape Colony. Communicated by Dr. Gill, F.R.S.

Since my communication[1] to the Royal Society of London, by Prof. Thomas R. Frazer, I have been able to obtain valuable additional evidence as to the communicability of the disease by the use of blood derived from animals which have been either recovered from the sickness for a very considerable time, or which have been inoculated many months previously to the date on which their blood has been used.

On December 8, 1898, I withdrew some blood from animal No. 18, which has been continuously under observation since it was inoculated on December 22, 1897. After defibrinating the blood, 20 c.c. was used to inoculate a young ox (No. 54) by intravenous injection. On the following day, a sharp rise of temperature occurred, which reached to 106°·6 F. On the following morning it was observed to have fallen to 99°·8 F. Three days later the temperature was again over 104° F., but fell previous to the next morning. From this time onward an erratic course of temperature was observed, and on the twenty-fifth day, subsequent to inoculation, it was seen to be ill; refused food, but had no definite symptoms of "red-water." Three days later it died. The blood on examination was seen to contain the spherical forms of the parasite.

On post-mortem examination, the bladder and urine were quite normal. The liver was not enlarged, but was somewhat discoloured in patches, and the biliary ducts were distended with bile. The bile was much altered, being stringy and of a greenish-yellow colour. The spleen was normal in size and consistence. The kidneys were enlarged, and the pelves were filled up by a yellowish gelatinous exudation. The cortex was somewhat congested, but there was no evidence of any true inflammatory change. The general muscles were pale in colour, and there was slight evidence of jaundice. This experiment serves to show that an animal which has been inoculated with infected blood, while it may not develop much illness as a result of it, is really infected and, moreover, its blood, if drawn as late as a year subsequently, is yet so infective that an intravenous injection of it, into susceptible animals, will certainly infect, and may even kill, although after a somewhat extended period of time.

Very important corroboration of this is furnished by the experience of inoculation for red-water, which has lately been adopted in the Cape Colony. Four animals which were immune to red-water (three by reason of having had the disease and recovered, and one by being born and reared on permanently infected veld) were sent from Fort Beaufort to Queenstown to be used by the veterinary surgeon there for inoculation purposes. The animals to be used for inoculation had been "fortified," *i.e.* re-inoculated with virulent blood, seven weeks previously.

Twenty animals were inoculated with defibrinated blood from one animal, the doses used being 10 to 20 c.c., according to age. All had a febrile reaction and some slight symptoms of the sickness, but easily recovered. From one of the other of the four animals blood was taken and used to inoculate seven head, giving doses of 10 to 15 c.c. These also all had a reaction, but made good recovery.

On November 1, the four animals were re-inoculated with virulent red-water blood, and in each case 5 c.c. was injected intravenously and 10 c.c. subcutaneously. Twenty-nine days later they were bled. With this blood two lots of cattle were inoculated.

One lot consisted of 107 animals which had not ever been exposed to red-water infection. The doses used were increased beyond those which I had recommended, namely, 10 to 25 c.c. were used, according to age. Of these animals no less than seventeen died of characteristic red-water. The remainder made a good recovery.

The second lot consisted of fifty-three head of cattle, all of which with one exception (an imported animal) had been born and reared on red-water veld. The imported animal was the only one which showed any signs of reaction, but it made a good recovery.

This experience has sufficed to show that it is not always safe to exceed the doses which I have recommended, unless the animals which have been used for withdrawing blood have been untouched for at least a considerable number of months.

I have been able, with the co-operation of several farmers, to carry out experiments by which inoculated cattle have been fully exposed to infection at later dates. In May 1898, I inoculated ten head of old cattle with blood from an animal which had been inoculated, six months previously, with virulent blood. These cattle were immediately removed from the Institute, and later sent to an infected area in company with ten head of young animals which were uninoculated, but, as is commonly known in this Colony, are not so liable to death from this disease as are older animals. Of the young stock all have been infected by exposure in the veld, and three have died. Of the older, more susceptible, animals not one has shown the slightest signs of illness, and the cows have given birth to healthy calves.

Mr. J. H. Webber had twenty-eight head of Fish River cattle inoculated on November 7, 1898, and subsequently had them removed to his farm, which is well known to be one of the worst infested areas in the eastern province. Previous experience has shown that if clean cattle are placed there they become very quickly affected with the disease. On December 5, one died from gall-sickness, but, with this exception, all have done very well, and are at this date in perfect health.

This method of inoculation has proved so satisfactory to the farmers themselves that it is being very generally adopted, and the farmers have petitioned the Government to arrange for an inoculating station being placed at Graham's Town, so that clean cattle coming from clean Karroo areas for transmission to the coast may be inoculated previous to entering the infested belt.

April 27.—"Data for the Problem of Evolution in Man. I. A First Study of the Variability and Correlation of the Hand." By Miss M. A. Whiteley, B.Sc., and Karl Pearson, F.R.S.

In a more purely theoretical discussion of the influence of natural selection on the variability and correlation of species, which one of the present writers hopes shortly to publish, a number of theorems are proved which it is desirable to illustrate numerically. But the quantitative measures of the variability and correlation hitherto published are comparatively few in number, especially when, as in the present case, we desire to have their values for a number of local races of the same species. When we have once realised that neither variability nor correlation are constant for local races but are modified in a determinate manner by natural selection and, perhaps, by use, and further that their differences are the key to the problem of how selection has differentiated local races, then the importance of putting on record all the quantitative measures we can possibly ascertain of variability and correlation becomes apparent.

This first study deals only with one character of the hand in one sex and one race. A wider range of material on the skeleton of the hand in another local race is already being dealt with. But while the correlation of the anatomically simple parts of the hand is of very great importance, it does not follow that the complex members of the living hand may not be equally, or even more, significant when we have to deal with fitness for the struggle for existence. So far as we have been able to ascertain, although much has been written as to the fitness of the hand for its tasks, no attempt has ever been made to ascertain quantitatively the degree of correlation of its parts.[1] Hence our first object was to get some idea of the correlation of the parts of the hand from an easily measured and in practice important part. Is the hand as highly correlated as the long bones, or as loosely correlated as the parts of the skull, or does it occupy some intermediate position like that of strength to stature? We accordingly selected as an easily measured but still important character the first joint of the fingers. The measurement therefore covers, besides the fleshy parts, the head of the metacarpal bone together with the proximal phalange. It is thus not anatomically simple, but it probably has much importance for the fitness of the hand, and is a measurement which with a little care can be made with considerable accuracy. Our measurements were taken with a small boxwood spanner graduated to 1/10 inch, and provided with a vernier, so that the readings could be nominally made to 1/100 inch. Both the hands of 551 women were measured.

---

[1] The conclusions arrived at in that communication (received June 6 1898) were as follows:—

1. The blood of animals, themselves healthy, from a red-water area is dangerous if inoculated into an animal which suffers coincidentally from another disease.

2. That the blood of animals suffering from mild or modified red-water may be safely used to inoculate a healthy animal *subcutaneously*, but is dangerous when injected into a vein.

3. That the subcutaneous inoculation of mild or modified red-water blood conveys a mild form of the disease, and since the blood of such an animal is virulent when injected into a vein in another animal, it is safely to be inferred that the animal suffering from the mild form becomes more or less immunised or "salted."

On these grounds, I would suggest a method of protective inoculation against red-water in the following manner. Having procured a healthy animal from a red-water area or one which is known to have been "salted," inoculate it by injecting 5 c.c. of red-water blood into the jugular vein and 5 c.c. subcutaneously. In cases where the operator is unable to attempt the vein inoculation, I would recommend the subcutaneous inoculation of 5 c.c. in four different sites.

Allow at least twenty-eight days to elapse, and if any degree of illness is recognised, the blood of this animal may be used, after being defibrinated, to inoculate healthy cattle. For such inoculation only 5 c.c. should be injected into small animals, and not more than 10 c.c. into larger.

Seeing, however, that the presence of other maladies renders such a proceeding unsafe, I would recommend that it should only be practised during the autumn or winter, when the veld diseases are, as a rule, in abeyance, and in no case when any epidemic disease is in the near neighbourhood.

Relative Size of the Hands.—We conclude that the first finger joints in the right hand are very sensibly larger than in the left. In every case there is a difference of about 0·02, and this is many times larger than the probable error of the difference, *i.e.* $\sqrt{2} \times 0{\cdot}003$ about.

We might, therefore, assert that the right hand is larger than the left. This conclusion is directly opposed to that of W. Pfitzner; he asserts that there is no quantitative difference between right and left for the simple anatomical parts of the hand skeleton. His own measurements, however, really do show such a sensible difference for the *first* phalange. All then we can say as yet is that the first joint and the first phalange are larger in the right than in the left hand of women. We prefer to state no more sweeping view at present as to other parts of the hand, however strong our private opinion may be.

Variability of the Hand.—If we were to judge by *absolute* variations the index and middle fingers of the right hand are less, the ring and little fingers more variable, than those of the left hand. But if we use the more reasonable coefficient of variation, we find that all the first joints for the left hand are more variable than the corresponding joints for the right hand, and this is precisely what we might expect if there be greater adaptation by selection, or by use of the right hand. The greater the selection, the less the variability.

In the left hand the relative order of variability (as measured by the coefficient of variation) is that of the relative size of the fingers; in the right hand this is slightly modified. It would appear that in the right hand the index finger is less variable than the middle finger. The general order of utility of the fingers would appear to be middle finger, index finger, ring finger, little finger, and this exactly agrees with the order of increasing variability in the left hand. The only doubt about this order appears in the relative efficiency and utility of the middle and index fingers, which have a different order of variability in the right hand.

As all our subjects belonged to the educated classes, it is just possible that the great use of the right hand index finger in writing has something to do with this diversity.

Correlation of the First Finger Joints.—The conclusions reached are: (1) The hand is a very highly correlated organ, far more highly correlated than the skull, and even somewhat more so than the long bones. We are accustomed to give man precedence in life on account of his brain power, and it might, perhaps, be thought that the brain case would be highly correlated in its parts. Yet what we find is that the skull is extremely individual, its correlations are low, and a man could be readily identified by head measurements, whereas hand measurements would be immensely less safe. In other words, the hand, so far as its dimensions go (we put aside markings), is far closer to a type than the skull.

(2) The parts of the left hand are distinctly more closely correlated than those of the right. The only exception is the correlation of right hand middle and little fingers, which is greater than that of left hand middle and index fingers; but the difference here is considerably less than the probable error of the difference, and the general rule appears to be quite certain. Now this is a most remarkable result; but, again, how is it to be interpreted? Is it a result of selection or a use effect? For the same organ it is a rule that the greater the selection the less the variability and the less the correlation. Exceptions there can be, which will be discussed elsewhere, but this appears to be the general rule. Is the less variability and correlation of the right hand a result of greater selection, or is it after all a result of use? If the latter, we see how hopeless it is to associate constancy of correlation, or even of regression coefficients, with the idea of local races. Indeed the further we enter into the quantitative side of the problem of evolution the more important appears the determination of the influence of growth and use on both variability and correlation. Why is the right hand less variable and less highly correlated than the left? Is the answer the same as to the question: Why is civilised man less variable and less highly correlated than civilised woman?

(3) The order of correlation of the first finger joints is identical for both hands. This order is as follows:—

(*a*) The external fingers have the least correlation and the little finger always less than the index.

(*b*) A finger has always more correlation with a second than with any other finger from which it is separated by the second.

(4) The correlation between corresponding members on both sides is discussed. It is found that again the extreme pairs show least correlation, and the pair of middle fingers higher correlation than the pair of ring fingers.

It is noted that the correlation between corresponding long bones (with the possible exception of that of the radii which is within the probable error of the value for the middle fingers) is greater than that between corresponding parts of the two hands.

The memoir indicates how important it is that the effect of use on both variation and correlation should be determined. It suggests that use may have differentiated in this manner the right from the left hand. But if it has affected variability and correlation here, how far can we look upon these quantities in local races as characteristic of the intensity of selection? The memoir concludes with numerical tables giving the results of the measurements made.

May 4.—"*Onygena equina* (Willd.): a Horn destroying Fungus." By H. Marshall Ward, D.Sc., F.R.S., Professor of Botany in the University of Cambridge.

The genus *Onygena* comprises half a dozen species of fungi, all very imperfectly known, remarkable for their growth on feathers, hair, horn, hoofs, &c., on which their sporocarps appear as drum-stick shaped bodies 5–10 mm. high. The author has recently investigated the life-history of the above species, growing on a cow's horn, and has not only verified what little was known as to its structure, but has been able to cultivate the fungus and trace its course of life, neither of which had been done before, and to supply some details of its action on the horn.

The principal new points concern the development of the sporophores, which arise as domed or club-shaped masses of hyphæ and stand up into the air covered with a glistening white powder. Closer investigation shows this to consist of a hitherto undiscovered form of spores—chlamydospores—developed at the free ends of the up-growing hyphæ. The details of their structure and development are fully described, and their spore nature proved by culture in hanging drops. The germination, growth into mycelia, and peculiar biology of these hitherto unknown spores were followed in detail, and in some cases new crops of chlamydospores obtained direct in the cultures.

The development of the peridium, asci, and ascospores were also followed in detail, and for the first time.

No one had hitherto been able to trace the germination of these ascospores—the only spores previously known in these fungi—and De Bary expressly stated his failure to do it. The author finds that they require digesting in gastric juice. By using artificial gastric juice, and employing glue and other products of hydrolysis of horn, the details of germination and growth into mycelia, capable of infecting horn, were traced step by step under the microscope and fully described.

The author also found that gastric digestion similarly promotes the germination of the chlamydospores, and in both cases has not only traced the germination step by step, but has made measurements of the growth of the mycelium, induced the formation of chlamydospores on the mycelium again, and by transferring vigorous young mycelia to thin shavings of horn has observed the infection of the latter.

---

[1] Here, as in other cases, both zoologists and anatomists have since the days of Cuvier, talked a good deal about correlation, but would even to-day be unable to reconstruct, with anything like *quantitative* accuracy, a skeleton from a long bone, a hand from a finger joint, or a skull from a fragment.

It thus becomes evident that the spores of *Onygena* pass through the body of an animal in nature, and, as might be expected from this, extract of the animal's dung also affords a suitable food medium for the fungus. Probably the cattle lick the *Onygena* spores from their own or each other's hides, hoofs, horns, &c., and this may explain why the fungus is so rarely observed on the living animal: it is recorded from such in at least one case however.

Very little is known as to the constitution of horn, and some experiments have been made to try to answer the question—what changes the fungus brings about. The research has bearings on the question of the decomposition of hair, horn, feathers, hoofs, &c., used as manure in agriculture; and may be not without significance in throwing light on the destruction of cuticle, hair, &c., by parasitic fungi.

"The Thermal Expansion of Pure Nickel and Cobalt." By A. E. Tutton, B.Sc. Communicated by Prof. Tilden, D.Sc., F.R.S.

The author has carried out a series of re-determinations of the coefficients of thermal expansion of these two metals with the aid of the interference dilatometer described in a former communication to the Society (*Phil. Trans.*, A, vol. cxci. p. 313; *Roy. Soc. Proc.*, vol. lxiii. p. 208). Since the determinations made by Fizeau in the year 1869, a large amount of additional knowledge has been accumulated with reference to nickel and cobalt, including the discovery of the liquid nickel carbonyl, which places processes of purification in the hands of the chemist of a character so superior to the older methods, as to render it highly desirable that re-determinations of the physical constants of these interesting elements should be carried out with specimens of the metals thus purified. By the kindness of Prof. Tilden, who has prepared such specimens with infinite care for the purposes of the investigation of other physical and chemical characters, the author has been enabled to carry out determinations of the thermal expansion with rectangular blocks varying in thickness from 8 to 13 mm. The blocks were furnished with parallel and truly plane surfaces by the makers of the dilatometer, Messrs. Troughton and Simms. The range of temperature of the observations was from 6° to 121°.

The results of the determinations of the coefficients of linear expansion α are as follows:—

$$\alpha = a + 2bt.$$

For nickel ... $\alpha = 0{\cdot}000\ 012\ 48 + 0{\cdot}000\ 000\ 014\ 8t.$

For cobalt ... $\alpha = 0{\cdot}000\ 012\ 08 + 0{\cdot}000\ 000\ 012\ 8t.$

The coefficients of linear expansion α of pure nickel and cobalt thus exhibit a slight but real difference, the coefficient of nickel being distinctly greater than that of cobalt. This is true with respect to both the constant a, the coefficient for 0°, and the increment per degree, $2b$, of the general expression for the coefficient at any temperature t, $\alpha = a + 2bt$. The difference is consequently one which augments with the temperature; at 0° it amounts to 3·2 per cent., while at 120°, the upper limit of the temperatures of the observations, it attains 4·5 per cent. Similar rules apply naturally to the cubical coefficients. The metal possessing the slightly lower atomic weight, nickel, is thus found to expand to a greater extent than the metal, cobalt, which is endowed with the higher atomic weight.

"Impact with a Liquid Surface, studied by the aid of Instantaneous Photography. Paper II." By A. M. Worthington, M.A., F.R.S., and R. S. Cole, M.A.

This paper is a continuation of a paper under a similar title, published in the *Philosophical Transactions*, vol. clxxxix., 1897.

It was there shown that, between the splash of a rough and of a polished sphere falling the same distance into water, there is a remarkable difference from the first moment of contact. The causes of this difference are now investigated.

The configuration of the water surface below the general level, when a rough sphere enters, is first studied by instantaneous photography, and the origin is traced of the bubble that follows in the wake of the sphere and of the emergent jet which follows its disappearance. The depression or crater formed round the entering sphere is surprisingly deep. This cavity segments, the lower part following as a bubble in the wake of the sphere, while the upper part fills up by the influx of surrounding water, which gathers velocity as it converges towards the axis of the disturbance, and so produces the upward spirt of the jet.

The actual displacement of the liquid has been studied by letting the sphere descend between two vertical slowly ascending streams of minute bubbles liberated by electrolysis from two pointed electrodes.

The splash of a smooth sphere is traced by gradual transition into that of a rough one as the height of fall is increased. But the course of the disturbance is largely dependent on minute differences in the condition of the surface, and even on its temperature. It was further found that dropping a smooth sphere through a flame, under certain conditions, invariably alters entirely the course of the splash. This action of the flame is proved to be no action of electrical discharge, and reasons are given for attributing it to the burning off of fine dust which has collected on the surface during the fall.

The influence of dust was proved by dusting one side only of a polished sphere, a proceeding which always results in completely changing the character of the splash on the dusted side.

A satisfactory general explanation of all the phenomera is found in the view that with a smooth sphere, cohesion is operative in guiding the advancing edge of the liquid sheath which rises over and closely envelops the sphere. If the surface is not rigid (*e.g.* is dusty), or is rough, then the momentum of the sheath carries it, once for all, away from the surface of the sphere, and the subsequent motion is quite different. The persistence of the remarkable radial ribs or flutings observable in the film that ensheaths a smooth entering sphere is completely explained by the assumption of a viscous drag spreading from the surface of the sphere outwards, and these flutings are always absent from any part of the sheath that has left the sphere. Their presence is thus an indication that there is no finite slip at the solid surface.

Experiments *in vacuo* show that the influence of the air is quite secondary. The similarity of the splash in a liquid with that due to the impact of a steel projectile on an armour-plate is referred to as requiring further investigation.

"The External Features in the Development of *Lepidosiren paradoxa*, Fitz." By J. Graham Kerr. Communicated by A. Sedgwick, F.R.S.

The eggs, averaging between 6·5 and 7 mm. in diameter, are deposited in a burrow at the bottom of the swamp. They are of a pale salmon colour without a trace of dark pigment. Segmentation closely resembles that of *Amia*. Gastrulation begins with the appearance of a row of depressions, or a continuous groove, running round about one-third of the length of the boundary between large and small cells. As this deepens to form the archenteron it shortens up, and the ultimately formed crescentic blastopore is only about a quarter of the length of the original groove. The medullary folds are low and inconspicuous, and meet behind the blastopore, which later becomes the anus. The over-arching of the medullary folds towards one another takes place to a certain extent, but the canal so covered in soon disappears, and the central canal of the nervous system is a secondary excavation. There is no trace externally of a *protostomal* seam running along the floor of the medullary groove. A somewhat tadpole-like larva hatches out, which assumes a remarkably amphibian appearance. This develops on each side four large pinnate external or somatic gills, upon branchial arches I, II, III, and IV. A large cement organ is also present, which during its early stages has the crescentic or U-shape so frequent in the embryos of Anura. Both cement organ and somatic gills are purely larval structures. During the atrophy of the latter they come by differential growth to be situated just over the fore limb, giving a similar condition to that well known in *Protopterus* of a larger growth.

The paper concludes with remarks of a general character upon the phenomena described.

Linnean Society, April 20.—Dr. A. Günther, F.R.S., President, in the chair.—Mr. George Murray, F.R.S., exhibited several slides of new *Peridiniaceae*, and gave some account of the method of collection by pumping, which had been found most efficacious with these organisms.—Mr. J. B. Carruthers communicated some observations on the localised nature of the parent characters in hybrid fruits of *Theobroma cacao*, on which some criticism was offered by the Rev. G. Henslow.—Mr. H. H. W. Pearson read a paper on the botany of the Ceylon "patanas," large savannahs in the forests at the same subtropical levels, and with the same climate, though not peculiar to Ceylon. These "patanas" appear to maintain their limits for long periods; but whether they thus exist on account of the burning of the grass in autumn, or by reason of some peculiarity in the climate, or exposure, is a question on which some difference of opinion has been expressed. A discussion followed, from which it appeared that the author of the paper had not definitely settled the problem.—The Rev. O. Pickard Cambridge, F.R.S., communicated a new list of British and Irish spiders. After reviewing the existing literature on the subject, and the materials which had come to hand since 1881 for a new and revised list of species, the author pointed out that the present paper was not intended merely for the use of authors or collectors interested in local faunas, but to give (with references to primary authorities) the spiders at present known to belong to Great Britain and Ireland, leaving the question of their distribution, abundance, or scarcity to be dealt with at some future time, when the present scanty number of spider-collectors might have increased. At present, large areas of varied natural characters, in some cases whole counties, and many maritime districts, were entirely unexplored, so far as the Arachnology is concerned.—Prof. R. J. Anderson communicated a paper entitled "Imitation as a source of anomalies." Commenting upon the statement made by Profs. Krause and Testut that muscular anomalies are rare in the lower animals, whilst in man they are very common, the author considered it remarkable that no single instance had been authenticated in recent times of a mammal fairly attempting to utter a human voice-sound, although this did not apply to birds. He suggested that in the attempt to imitate, the mental act, or volition, if sustained, might favour a change of a moderate nature, and that such a change might be either progressive or retrogressive.

Geological Society, April 26.—W. Whitaker, F.R.S., President, in the chair.—Prof. Emmanuel Kayser, of Marburg, was elected a Foreign Member; and Prof. Franz Lœwinson-Lessing, of Dorpat, and Prof. R. Zeiller, of Paris, were elected Foreign Correspondents of the Society.—On limestone-knolls in the Craven district of Yorkshire and elsewhere, by J. E. Marr, F.R.S. The author begins with a general account of the district, partly founded on the published work of Mr. R. H. Tiddeman, but substantiated by his own observations. The Lower Carboniferous rocks north of the Craven Fault-system differ in character and thickness from those on the south; they exhibit little disturbance on the north, but on the south they are thrown into a series of folds, while it is also on this side that the knobs of limestone called *knoll-reefs* by Mr. Tiddeman occur. The prominent features of the knolls are the crystalline character of the limestone, the horizontality of bedding in the interior of the knolls, the general parallelism of the bedding of the exterior to the contour of the knolls, and the obscurity of the bedding. Fossils, when present, are usually very perfectly preserved and undistorted; breccias are frequently found in the shales bordering the knolls and, much less commonly, in the limestone of a knoll itself. Evidence of movement in the knolls is seen in the lenticular character of the beds of limestone, in visible folded structures, the termination of lenticular beds in hooks against a divisional plane, and in the shales by the presence of a structure undistinguishable from cleavage. Dolomitised and silicified limestones are frequently associated with the knolls, and the perfection of the quartz-crystals in certain examples of the latter variety of rock suggests crystallisation during relief of pressure. The breccias belong to three main types: (1) Fragments of limestone in a matrix of similar material; (2) large nodules of black limestone enwrapped in shales; (3) various limestone-fragments in a fine calcareous paste. Examples of each type are described, and each is explained as resulting from some form of earth-movement. Breccias of similar types are found to be produced out of grit-fragments, and in places the grits are found to be piled together by faulting so as to produce knolls, which somewhat resemble those in the limestone. Dealing with the nature of the movements, the writer argues that the Middle Craven Fault is an overthrust from the north, and that the Limestone Series has undergone differential movements with respect to the hard Lower Palæozoic rocks beneath and the massive Millstone Grit above. The limestones have been squeezed-out from under the synclines, and they have accumulated under the anticlines where the pressure was relieved. In conclusion, a number of examples of knolls are cited from other localities which show similar features, such as the limestones of Keisley, Millom, and near Dalton-in-Furness, some of the Devonian limestones near Torquay, the *Leptaena*-limestone of Dalecarlia, and the Devonian limestone of Koñeprus in Bohemia.—The limestone-knolls below Thorpe Fell, between Skipton and Grassington in Craven, by J. R. Dakyns. A band of limestone runs from Cracoe towards the north-east, folded in an anticline and dipping under shales. In several places the top of the limestone is brecciated and the overlying (Bowland) shale contains fragments of limestone. The limestone forms five abrupt conspicuous hills. The rocks in most of these hills are not bedded, and where they are bedded the dip is confusing; both in exposures outside of these and in adits inside, the limestone in some cases is amorphous and without any sign of bedding. The author considers the absence of bedding in the limestone to be a very important feature; for in the country south of the North Craven Fault, though the rock is excessively contorted, its bedding has not been destroyed.—On three species of Lamellibranchs from the Carboniferous Rocks of Great Britain, by Dr. Wheelton Hind. The first part of this paper describes a new species of *Anthracomya* which occurs in the North Staffordshire and Manchester coalfields at horizons higher than that characterised by *A. Phillipsi*. The fossil is found at Etruria, Bradwell, Stoke-on-Trent, and Fallowfield. It appears to indicate a special zone of shales and *Spirorbis*-limestone about 300 feet below the Penkhull Sandstone, and to be the only molluscan form known from the zone. A new species of *Carbonicola* is next described, partly from specimens previously supposed to be a gasteropod, a brachiopod, or even a crustacean, and partly from better-preserved specimens obtained from calcareous bands about ten yards above the Bassey Mine Ironstone in North Staffordshire. It appears to be the latest species of this genus known, and to occur in higher beds than any other species. Lastly, a new species of *Ctenodonta* from Penton Linns (Dumfriesshire) is described. It occurs in a marine shale below the highest limestone of the locality, in beds referred to the horizon of the Hurlet Limestone by the officers of the Geological Survey. The bed contains gasteropods, crinoids, cephalopods, &c., with *Productus giganteus*. The species has some resemblance to *C. Halli*, Barrois, found in Spain.

DUBLIN.

Royal Dublin Society, March 22.—Prof. D. J. Cunningham, F.R.S., in the chair.—Dr. G. Johnstone Stoney, F.R.S., read a paper entitled "Survey of that part of the range of nature's operations which man is competent to study."—April 19.—Prof. G. F. FitzGerald, F.R.S., in the chair.—Prof. Letts and Mr. R. F. Blake presented the second part of their paper on the carbonic anhydride of the atmosphere, dealing with the amount and causes of variation. The authors discuss (1) the chief natural causes of evolution, (2) those of absorption, and (3) the regulating agencies, and suggest that the chief permanent natural source of evolution—namely, volcanic and subterranean emanations of carbonic anhydride—is kept in check by the absorption of the gas during rock disintegration, and eventually by cretaceous organisms which permanently remove (though of course indirectly) carbonic anhydride from the atmosphere, thus diminishing the supply of carbon necessary for the sphere of organic action. They also suggest that this "degradation" of carbon may finally lead to the extinction of all life on the globe. In the second section of the paper, the question of the temporary fluctuations in the amount of atmospheric carbonic anhydride is considered. These at the lowest estimate at times reach 10 per cent. of the total quantity. Each of the chief natural causes inducing these variations, or supposed to induce them, is discussed and the evidence reviewed; also the *rôle* which ground air plays in the phenomenon is considered. They present with the memoir a very carefully compiled list of the chief original papers which have appeared on the subject, as well as the abstracts of them.—Prof. G. F. FitzGerald communicated a paper, by Mr. D. H. Hall, on the concentration of soap solution on the surface of the liquid. This paper records the results of experiments to determine whether there is any concentration of soap solution in the superficial film of the liquid. The results showed that the soapy matter is so concentrated.—Dr. R. F. Scharff communicated a report on the Crustacea Schizopoda of Ireland, by Messrs. Ernest W. L. Holt and W. I. Beaumont, in connection with the Royal Dublin Society's Survey of Fishing Grounds on the West Coast of Ireland. The report includes a complete list of all Schizopods recorded from Irish localities. Two species, *Parerythrops obesa*, G.O.S., and *Mysidella typica*, G.O.S., are added to the British list. A new genus, Dasymysis, is erected for the reception of *Mysis longicornis*, M.-Edw., Czerniavsky's genus

Acanthomysis having been defined in such a manner as to exclude the type. Reasons are given for doubting the specific validity of *Macromysis neglecta*, G.O.S., and the characters of *Erythrops serrata*, G.O.S., are re-defined.—Prof. J. Joly, F.R.S., communicated a paper, by Mr. Kingsley D. Doyle, on the Rio del Fuerte of Western Mexico and its tributaries. The paper is a valuable series of notes, arranged topographically, concerning the geology, physical geography, and meteorology of the district explored.

Edinburgh.

Royal Society, May 1.—Prof. Copeland in the chair.—Lord Kelvin's paper on the application of force within a limited space required to produce spherical solitary waves, or trains of waves, of both or either species, equivoluminal and irrotational, in an elastic solid, was briefly described. It will be found in the May number of the *Philosophical Magazine*.—Dr. Alexander Galt, in a further communication on the heat of combination of pairs of solid metals, mentioned that practically there was no heat of combination in copper-silver alloys, but that heat of combination was found in most of the copper-zinc alloys. The maximum was obtained when the metals, considered as bivalent elements, were in proportions approximating to their chemical combining proportions—about 49·8 per cent. copper. With diminishing percentage of copper, the heat of combination gradually diminished, becoming zero when there was about 30 per cent. of copper. With still smaller proportion of copper, *the heat of combination became negative*.—Dr. C. Wace Carlier read a paper on changes that occur in some cells of the newt's stomach during digestion. As soon as food is swallowed, secretion commences near the œsophagus and sweeps in a slow wave along the whole organ, reaching the pyloric glands in one to two hours. Each cell is exhausted in about four hours, following which there is a period of rest and recuperation lasting other four hours. During exhaustion, the nuclei undergo changes in size, losing chromatin, which is used up in the production of prozymogen. The nucleoli are effete products, derived mainly from the chromatin, and are extruded from the nuclei. The prozymogen passes into the cytoplasm and unites with an albuminous material to form zymogen, which is readily converted into zymin by the action of weak acids. Repair of chromatin begins by the passage into it of substances from the cytoplasm. These become gradually broken up, the nuclear radicle passing to the chromatin, and the albuminous material to the nucleoli as effete matter. When (but not until) this process is complete, the cell is again ready to recommence secretion if called upon to do so. Oxyutic cells divide by mytosis, and, in process of division, secrete zymin and form prozymogen from the chromatin just as cells not in process of division do.—In a paper on the leakage of electricity from charged bodies at moderate temperatures, Prof. J. C. Beattie described in detail results of experiments with zinc and iron plates coated with various substances. Under any given condition the rate of leakage of charge from the insulated plate was determined (1) at ordinary temperatures; (2) at temperatures of 150°-300° C. With the plate by itself or covered by certain materials there was no change in the rate of leakage as the temperature was raised. With certain coatings, however, there was greatly increased leakage at the higher temperatures. This was the case, for example, when zinc was coated with potassium bichromate and iodine; and when iron was coated with potassium permanganate or with potassium acetate.—Professor Tait, in a note on the linear and vector function, showed that if ϕ represented a strain with three real roots, so also did $\psi \phi \psi^{-1}$ where ψ was any linear and vector function whatever. As formerly shown, ϕ may be written as the product, $\omega \pi$, of two pure strains. Hence $\psi \phi \psi^{-1} = \psi \omega \psi' . \psi'^{-1} \pi \psi^{-1}$, in which each triple compound is obviously self-conjugate, and hence $\psi \phi \psi^{-1}$ can also be expressed as the product of two pure strains.

Paris.

Academy of Sciences, May 15.—M. van Tieghem in the chair.—M. Prillieux took his place as a member of the Botanical Section.—Experimental application of decimal circular divisions in practical navigation, by M. E. Guyou. An account of some experiments to be undertaken on the extension of the decimal system to the instruments and tables employed in navigation. The advantages of the system and the difficulties attending its introduction are discussed.—Effects of auto-excitation of the heart by the extra-current of the electromagnetic indicator used in recording cardiac valvular movements, by M. A. Chauveau. Further experiments are described, showing the extreme sensitiveness to induced currents of the heart of the horse.—New elements of the orbit of the planet EL, by MM. Lubrano and Maitre.—Representation of uniform branches of analytic functions, by M. G. Mittag-Leffler.—Calculation of formulæ containing arbitrary functions, by M. Jules Beudon.—Want of generality in the theory of the fictitious polarisation of dielectrics, by M. H. Pellat. The theory in question is incapable of explaining the forces produced when a dielectric, originally non-electrified, is placed in an electric field.—Influence of the source of electricity in the use of Michelson's vacuum tubes, by MM. A. Perot and Ch. Fabry. The best results, as regards the production of phenomena of interference, are obtained by the use of a continuous current with an electromotive force of at least 700 or 800 volts.—On the electrolytic luminous sheath, by M. E. Lagrange.—Substitution of magnetic for mechanical action in coherers, by M. Th. Tommasina. The chains formed by the metallic particles are broken by the action of an electromagnet.—Transmission of light through turbid media, by M. P. Compan. It is shown experimentally that the nature of the light transmitted by turbid media is dependent on the dimensions of the suspended particles.—Calculation of the compressibility of a gaseous mixture from the compressibility of its components, by M. Daniel Berthelot. The method of calculation is based on Van der Waals' formula, and the theoretical numbers show a satisfactory agreement with the experimental values.—On the preparation and properties of tungsten pentabromide, by M. Ed. Defacqz. A new method for the preparation of tungsten pentabromide is described, based on the action of dry hydrogen bromide on the hexachloride at about 300° C. The satisfactory yield obtained by this process enabled the properties of the compound to be studied more completely than has hitherto been possible.—On the mixed halogen salts of lead, by M. V. Thomas. The author describes a bromochloride of the formula $3PbCl_2, PbBr_2$, obtained by mixing solutions of lead chloride and potassium bromide, a bromochloride PbBrCl formed by the action of bromine on the corresponding chloriodide which has previously been described, and a bromoiodide of the formula $3PbBr_2, PbI_2$. A bromoiodide having the composition PbBrI also appears to exist.—Separation and estimation of traces of bromine in the presence of a large excess of chlorides, by M. H. Baubigny. The bromine is separated from the bulk of the chlorine by distilling the salts with potassium permanganate and a limited quantity of hydrochloric acid. Less than 0·0005 gramme of bromine may thus be detected and estimated in the presence of 10 grammes of sodium chloride.—On the activity of manganese in relation to the phosphorescence of strontium sulphide, by M. José Rodriguez Mourelo. The influence of manganese carbonate, in rendering strontium sulphide phosphorescent, is similar to that of bismuth subnitrate as described in previous communications.—On pectins, by M. Em. Bourquelot. Five varieties of pectin, obtained from different plants, have now been examined. All are dextrorotatory to a greater or less extent, and their solutions are coagulated by pectase. On hydrolysis with dilute sulphuric acid arabinose is obtained, whilst mucic acid is formed on oxidation with nitric acid.—Action of toluylene-diamine on the red corpuscles of the blood, by MM. L. Lapicque and A. Vast. Experiments tend to show that the toxic action of toluylene-diamine is due not so much to a specific destruction of the corpuscles as to an alteration of the latter which facilitates their destruction by the hæmatolytic organs, and especially by the liver.—On the galvanotropism of ciliated infusoria, by M. Henri Mouton. The phenomenon of galvanotropism appears to be due to the direct action of the current, and not to the chemiotropic action of the products of electrolysis.—On the forms of conservation and reproduction of "black rot," by M. Joseph Perraud. It follows, from the author's observations, that burying the affected parts of the plant is of no avail unless the soil is subsequently left undisturbed.—*Botrytis cinerea* and the "Toile" disease, by M. J. Beauverie. The destructive action of the parasite is favoured by a high temperature, a moderately nutritive substratum, and a confined atmosphere saturated with aqueous vapour.—On the germination of *Neottia nidus-avis*, by M. Noel Bernard.—On a *tachylite* from the bed of the North Atlantic Ocean, by M. P. Termier.

Amsterdam.

Royal Academy of Sciences, March 25.—Prof. van de Sande Bakhuyzen in the chair.—Prof. Zaayer reported, both on behalf of Prof. Fockema Andreae and himself, upon a letter from the Minister of the Interior, concerning the question addressed by the Belgian Ambassador to the Dutch Government with respect to prize essays.—Prof. Pekelharing reported, both on behalf of Prof. Winkler and himself, on the paper of Dr. G. C. van Walsem, entitled "An attempt at a systematical method of the normal and pathological microscopo-anatomical and anthropological inquiry into the central nervous system." This paper will be published in the Academy's *Transactions*.—Prof. J. C. Kluyver, on reducible hyperelliptic integrals. The paper deals with the algebraic conditions to be satisfied by hyperelliptic equations, when it is possible by a theta transformation of the r-order to arrive at a period matrix of which the constituents, all but the first, are equal to zero. Particularly the cases $p = 2, 3$, $r = 2, 3$ are considered. An expression of the invariant relation between the branch places is given for the case $p = 2$, $r = 3$, also a proof for the special form of the reducible integral, mentioned by Prof. Burnside (*Proc. Lond. Math. Soc.*, vol. xxiii.).—Prof. Winkler, on inquiries, made by Mr. Wiardi Beckman and himself, into the influence that expiration undergoes through faradic irritation of certain sensible and sensory nerves.—Mr. Hamburger, on the influence of salt solutions on the volume of animal cells (second communication).—Prof. Van der Waals, on an anomaly in the course of the plait-point curve in the case of a mixture of anomalous substances. All these communications will be inserted in the *Proceedings*.—The following papers were also presented for publication in the *Proceedings*: Prof. Van der Waals, on volume and pressure contraction (iii.); and on behalf of Prof. L. Boltzmann, foreign member of the Academy, on the characteristic equation of Van der Waals.—Prof. Kamerlingh Onnes, on behalf of Dr. E. van Everdingen, jun., on the galvanomagnetic and thermomagnetic phenomena in bismuth (second communication).—Prof. Bakhuis Roozeboom, on behalf of Dr. Ernst Cohen, on electrical reaction velocity.

April 22.—Prof. Van de Sande Bakhuyzen in the chair.—Prof. Bakhuis Roozeboom communicated the first experiments, made for the confirmation of his theoretical views, concerning the melting points of optical isomers. These views were confirmed in the case of mixtures, both of racemic and dextro-dimethylethereal salts of tartaric acid and of the same derivatives of diacetyltartaric acid. In the first system, the inactive ester had a higher melting point than the active one; in the second system, it was just the opposite.—Prof. Kamerlingh Onnes presented, on behalf of Dr. E. van Everdingen, jun., a communication concerning the galvanomagnetic and thermomagnetic phenomena in bismuth (a continuation of the second communication).—Prof. Van der Waals presented a paper on the deduction of the phase equation, being a controversy with Prof. Boltzmann.

DIARY OF SOCIETIES.

THURSDAY, May 25.

Royal Institution, at 3.—Water Weeds: Prof. L. C. Miall, F.R.S.

FRIDAY, May 26.

Royal Institution, at 9.—Climbs and Explorations in the Andes: Sir W. Martin Conway.

Physical Society, at 5.—On the Thermal Properties of Normal Pentane, Part 2: Prof. S. Young and Mr. Rose-Innes.—On the Distribution of Magnetic Induction in a Long Iron Bar: C. G. Lamb.

Aeronautical Society, at 8.—Exhibition of Models: Lawrence Hargrave and Dr. Barton.

MONDAY, May 29.

Royal Geographical Society, at 8.30.—Explorations in Patagonia and the Eastern Andes: Dr. Francisco Moreno.

TUESDAY, May 30.

Royal Institution, at 3.—Recent Advances in Geology: Prof. W. J. Sollas, F.R.S.

Society of Arts, at 8.—The Revival of Tradesmen's Signs: J. Starkie Gardner.

Anthropological Institute, at 8.30.—On the Beginnings of Currency: Lieut.-Colonel R. C. Temple.

THURSDAY, June 1.

Royal Society, at 4.—Election of Fellows. —At 4.30—*Probable Papers*: The Parent-Rock of the Diamond in South Africa: Prof. T. G. Bonney, F.R.S.—Results of Experiments in Telegony: Prof. Ewart, F.R.S.

Royal Institution, at 3.—Water Weeds: Prof. L. C. Miall, F.R.S.

Linnean Society, at 8.—On the High Level Plants of the Andes as illustrated by the Collections of Sir W. Martin Conway, Mr. Edward Whymper, and others: W. Botting Hemsley, F.R.S.—On some Australasian Collembola: Sir John Lubbock, Bart., F.R.S.

Society of Arts, at 4.30.—The Port of Calcutta: Sir Charles Cecil Stevens, K.C.S.I.

Chemical Society, at 8.—The Hydrosulphides, Sulphides, and Polysulphides of Potassium and Sodium: W. Popplewell Bloxam.—On the Relative Efficiency of various Forms of Still-head for Fractional Distillation: Dr. Sydney Young, F.R.S.—The Salts of Dimethylpyrone, and the Tetravalence of Oxygen: Dr. J. N. Collie, F.R.S., and Thomas Tickle.

SATURDAY, June 3.

Royal Institution, at 3.—The Music of India and the East, and its Influence on the Music of Europe (with Musical Illustrations): Edgar F. Jacques.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Books.—Sewage-Analysis: J. A. Wanklyn and W. J. Cooper (Paul).—Anleitung zur Darstellung Chemischer Präparate: Prof. H. Erdmann, Zweite Auflage (Frankfurt a.M., Bechhold).—Einleitung in die Vergleichende Gehirnphysiologie und Vergleichende Psychologie: Dr. J. Loeb (Leipzig, Barth).—Accounts of the Trade carried by Rail and River in India, 1897–98, &c. (Calcutta).—Flora of Kent: F. J. Hanbury and E. S. Marshall (Hanbury).—A Treatise on Practical Chemistry, &c.: Dr. F. Clowes, 7th edition (Churchill).—Die Entstehung des Lebens: Dr. L. Zehnder, 1 Teil (Freiburg i.B., Mohr).—Cries and Call Notes of Wild Birds: C. A. Witchell (Gill).—Man, Past and Present: A. H. Keane (Cambridge University Press).—A Select Bibliography of Chemistry: H. C. Bolton, 1st Supplement (Washington).—Wetterprognosen und Wetterberichte des xv. und xvi. Jahrhunderts (Berlin, Asher)

Pamphlets.—Hey for the Holidays! (R. E. Taylor).—Sull' Impiego del Microsismografo, &c. (Venezia, Ferrari).—History and Present Status of Instruction in Cooking in the Public Schools of New York City (Washington).—The Slide-Valve Simply Explained: W. J. Tennant (Dawbarn).

Serials.—Zeitschrift für Wissenschaftliche Zoologie, lxv. Bd., 4 Heft (Leipzig).—Die Meteorologie der Sonne und das Wetter im Jahre 1889, &c.: Prof. K. W. Zenger (Prag, Řivnáč).—Knowledge, May (Witherby).—Journal of the Chemical Society, Supplementary Number (Gurney).—Memoirs and Proceedings of the Manchester Literary and Philosophical Society, Vol. 43, Part 1 (Manchester).—Atlantic Monthly, May (Gay).—Atti della Fondazione Scientifica Cagnola della sua Istituzione in Poi, 1896–97, 1897–98 (Milano).—Zoologist, May (West).—Physical Society of London Proceedings, May (Taylor).—Morphologisches Jahrbuch, 27 Bd. 2 Heft (Leipzig).—Journal of the Franklin Institute, May (Philadelphia)—Popular Astronomy, May (Northfield, Minn.).—Psychological Review, Monograph Supplement, Vol. 2, No. 5 (Macmillan).—American Anthropologist, April (Putnam).—Astrophysical Journal, April (Chicago).—Proceedings and Transactions of the Nova Scotian Institute of Science, Vol. ix. Part 4 (Halifax, N.S.).—Proceedings of the Academy of Natural Sciences, 1898, September–December (Philadelphia).—Annals of the Astronomical Observatory of Harvard College, Vol. xxxix. Part 1 (Cambridge, Mass.).—Royal Magazine, June (Pearson).

CONTENTS.

PAGE

Recent Works on Medical Science. By **F. W. T.** . 73
Routh's Dynamics of a Particle. By **C. G. K.** . . . 74
Laboratory Manuals of Inorganic Chemistry. By **A. S.** 76
The Modern Bicycle. By **A. S.** 77

Our Book Shelf:—

Lachman: "The Spirit of Organic Chemistry."—**J. B. C.** 78
Gregory and Simmons: "Elementary Physics and Chemistry. First Stage" 78

Letters to the Editor:—

Mangroves Growing in Japan. (*Illustrated.*)—**Prof. Tokutaro Ito** 79
The Development of the Tuatara.—**Prof. Wm. Blaxland Benham** 79
The Gipsy Moth and its Introduction into America. (*Illustrated.*) By **W. F. Kirby** 80
The Australasian Association 82
Sir Frederick McCoy, K.C.M.G., F.R.S., &c. By **H. B. W.** 83
The Edinburgh Chair of Physiology 84
Notes (*Illustrated.*) 84

Our Astronomical Column:—

New Star in Sagittarius 88
Comet 1899 *a* (Swift) 88
The Registration of Opticians 88
University and Educational Intelligence 90
Scientific Serials 90
Societies and Academies 91
Diary of Societies 96
Books, Pamphlets, and Serials Received 96